In re Patent Application of
ESPOSITO CORCIONE ET AL.
Serial No. **Not Yet Assigned**
Filed: **Herewith**
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In the Claims:

Claims 1-10 (Cancelled).

11. (New) An electronic torque control and distribution system for a hybrid propulsion vehicle wherein a drive thrust of the vehicle is distributed between an electric engine and an internal combustion engine through a transmission system delivering torque of both engines to wheels of the vehicle, the system comprising:

a control unit for controlling the transmission system;

a controller connected to said control unit and comprising a fuzzy logic processor for predicting through soft computing techniques torque contributions of the electric engine and of the internal combustion engine; and

a sensor connected to said control unit for estimating polluting emissions from the vehicle.

12. (New) A system according to Claim 11, wherein said controller and said control unit receive as input a predetermined number of operating parameters of the vehicle and of the engines, and respectively comprise control outputs for actuator elements of the vehicle and for the engines; and wherein said controller further comprises a control output for providing a torque request to said control unit.

13. (New) A system according to Claim 12, wherein the actuator elements of the vehicle comprise at least one of a clutch and the transmission system.

14. (New) A system according to Claim 12, wherein

said controller receives at least one of the following inputs: path profiles (road noise), driving commands (pedals), system component status (system status), fuel mass capacity (fuel amount), electric drive phase currents, battery supplied current, and transmission system status (transmission position).

15. (New) A system according to Claim 11, wherein the internal combustion engine operates at steady state, and wherein additional torque required by the vehicle is provided by the electric engine.

16. (New) A system according to Claim 11, wherein the vehicle comprises batteries for supplying energy to the electric engine; and wherein said fuzzy logic processor in said controller receives as input at least one of a state-of-charge (soc) signal of the batteries supplying the electric engine and a signal (cycle) indicating a path calculated based upon an average and variance of the vehicle speed.

17. (New) A system according to Claim 16, wherein the signal indicating the calculated path is recalculated at predetermined time intervals.

18. (New) A system according to Claim 11, wherein said control unit receives the following inputs: electric drive phase currents, electric machine angular speed, thermal machine angular speed, thermal engine timing, out-vehicle conditions (atmospheric pressure and temperature), and a torque requests output by said controller.

19. (New) A system according to Claim 16, wherein said fuzzy logic processor operates on membership functions according to the following fuzzy interference rules:

A) if (cycle is off) and (soc is not soc_low) then (Tice is 0) (time is 0);

B) if (cycle is urban) and (soc is not soc_low) then (Tice is 0) (time is 1);

C) if (cycle is comb) and (soc is not soc_low) then (Tice is 50) (time is 1);

D) if (cycle is extra) and (soc is not soc_low) then (Tice is 50) (time is 1); and

E) if (soc is soc_low) then (Tice is 100) (time is 0).

20. (New) A system according to Claim 11, wherein said control unit provides an output signal defining a fuel capacity required for the internal combustion engine, with the output signal being provided through said sensor.

21. (New) A system according to Claim 11, wherein the predicting is performed by monitoring a present vehicle state and a past history related to driving conditions based upon data stored in said controller.

22. (New) A hybrid propulsion vehicle comprising:

an electric engine;

an internal combustion engine;

at least one axle;

a transmission system delivering torque from said electric energy and said internal combustion engine to said at least one axle; and

an electronic torque control and distribution system comprising

a control unit for controlling said transmission system,

a controller connected to said control unit and comprising a fuzzy logic processor for predicting contributions of said electric engine and of said internal combustion engine, and

a sensor connected to said control unit for estimating polluting emissions from the vehicle.

23. (New) A vehicle according to Claim 22, further comprising at least one actuator element; wherein said controller and said control unit receive as input a predetermined number of operating parameters of the vehicle and of said engines, and respectively comprise control outputs for said at least one actuator element and for said engines; and wherein said controller further comprises a control output for providing a torque request to said control unit.

24. (New) A vehicle according to Claim 23, wherein said at least one actuator element comprises a clutch.

25. (New) A vehicle according to Claim 23, wherein said controller receives at least one of the following inputs: path profiles (road noise), driving commands (pedals), system component status (system status), fuel mass capacity (fuel amount), electric drive phase currents, battery supplied current, and transmission system status (transmission position).

26. (New) A vehicle according to Claim 22, wherein said internal combustion engine operates at steady state, and wherein additional torque required by the vehicle is provided by said electric engine.

27. (New) A vehicle according to Claim 22, further comprising at least one battery for supplying energy to said electric engine; and wherein said fuzzy logic processor in said controller receives as input at least one of a state-of-charge (soc) signal of said at least one battery supplying said electric engine and a signal (cycle) indicating a path calculated based upon an average and variance of the vehicle speed.

28. (New) A vehicle according to Claim 27, wherein the signal indicating the calculated path is recalculated at predetermined time intervals.

29. (New) A vehicle according to Claim 22, wherein said control unit receives the following inputs: electric drive phase currents, electric machine angular speed, thermal machine angular speed, thermal engine timing, out-vehicle conditions (atmospheric pressure and temperature), and a torque requests output by said controller.

30. (New) A vehicle according to Claim 27, wherein said fuzzy logic processor operates on membership functions according to the following fuzzy interference rules:

A) if (cycle is off) and (soc is not soc_low) then (Tice is 0) (time is 0);

B) if (cycle is urban) and (soc is not soc_low)

then (Tice is 0) (time is 1);

C) if (cycle is comb) and (soc is not soc_low) then (Tice is 50) (time is 1);

D) if (cycle is extra) and (soc is not soc_low) then (Tice is 50) (time is 1); and

E) if (soc is soc_low) then (Tice is 100) (time is 0).

31. (New) A vehicle according to Claim 22, wherein said control unit provides an output signal defining a fuel capacity required for said internal combustion engine, the output signal being provided via said sensor.

32. (New) A vehicle according to Claim 22, wherein the predicting is performed by monitoring a present vehicle state and a past history related to driving conditions based upon data stored in said controller.

33. (New) A method for providing electronic torque control and distribution in a hybrid propulsion vehicle wherein a drive thrust of the vehicle is distributed between an electric engine and an internal combustion engine through a transmission system delivering torque of both engines to wheels of the vehicle, the method comprising:

controlling the transmission system using a control unit;

predicting torque contributions of the electric engine and of the internal combustion engine using a controller connected to the control unit, the controller comprising a fuzzy logic processor for performing the predicting through soft computing techniques; and

estimating polluting emissions from the vehicle using a sensor connected to the control unit.

34. (New) A method according to Claim 33, wherein the controller and the control unit receive as input a predetermined number of operating parameters of the vehicle and of the engines, and respectively comprise control outputs for actuator elements of the vehicle and for the engines; and wherein the controller further comprises a control output for providing a torque request to the control unit.

35. (New) A method according to Claim 34, wherein the actuator elements of the vehicle comprise at least one of a clutch and the transmission system.

36. (New) A method according to Claim 34, wherein said controller receives at least one of the following inputs: path profiles (road noise), driving commands (pedals), system component status (system status), fuel mass capacity (fuel amount), electric drive phase currents, battery supplied current, and transmission system status (transmission position).

37. (New) A method according to Claim 33, wherein the internal combustion engine operates at steady state, and wherein additional torque required by the vehicle is provided by the electric engine.

38. (New) A method according to Claim 33, wherein the vehicle comprises batteries for supplying energy to the electric engine; and wherein the fuzzy logic processor in the

controller receives as input at least one of a state-of-charge (soc) signal of the batteries supplying the electric engine and a signal (cycle) indicating a path calculated based upon an average and variance of the vehicle speed.

39. (New) A method according to Claim 38, wherein the signal indicating the calculated path is recalculated at predetermined time intervals.

40. (New) A method according to Claim 33, wherein the control unit receives the following inputs: electric drive phase currents, electric machine angular speed, thermal machine angular speed, thermal engine timing, out-vehicle conditions (atmospheric pressure and temperature), and a torque requests output by said controller.

41. (New) A method according to Claim 38, wherein the fuzzy logic processor operates on membership functions according to the following fuzzy interference rules:

A) if (cycle is off) and (soc is not soc_low) then (Tice is 0) (time is 0);

B) if (cycle is urban) and (soc is not soc_low) then (Tice is 0) (time is 1);

C) if (cycle is comb) and (soc is not soc_low) then (Tice is 50) (time is 1);

D) if (cycle is extra) and (soc is not soc_low) then (Tice is 50) (time is 1); and

E) if (soc is soc_low) then (Tice is 100) (time is 0).

42. (New) A method according to Claim 33, wherein

the control unit provides an output signal defining a fuel capacity required for the internal combustion engine, with the output signal being provided through the sensor.

43. (New) A method according to Claim 33, wherein the predicting is performed by monitoring a present vehicle state and a past history related to driving conditions based upon a plurality of data stored in said controller.